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# Heterogeneous distribution of Fe in olivine induced by serpentinization

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Murata et al. (2009a, b) reported the presence of conspicuous Fe-rich stripes in olivine grains included in serpentinized peridotite which was sampled from serpentinite seamounts along the Mariana trench. They assumed that the Fe-rich stripes were produced by Fe-rich fluid generated through the serpentinization of peridotite (Murata et al. 2009b). We studied more detail the process making Fe-rich stripes with transmission electron microscopy (TEM) and analytical transmission electron microscopy (ATEM). The occurrence of such chemical heterogeneity in the altered olivine might be a key to understand the physicochemical interaction between the fluid and olivine at the initial stage of the serpentinization process.
Fe-rich stripes with a ca. 4.5 um intervals are found within residual olivine grains. Distribution of the stripes is limited only to the areas in contact with antigorite peridotite. We prepared TEM foils from the areas showing the Fe-rich stripe using the Focused Ion Beam technique. TEM examinations on the foils clearly indicate that the Fe-rich stripes are attributed to the dislocation arrays creating (100) sub-grain boundaries. These dislocations have [100] Burgers vector. Chemical analyses by ATEM reveal that each dislocation core and its vicinity have ca. Fo 88 mol %, which is 3-4 mol% lower than the surrounding regions and unaltered olivine grains. This fact ensures that Fe enrichment occurs along the sub-grain boundaries, namely dislocation arrays. Therefore, this phenomenon can be interpreted as the result of interdiffusion between Mg and Fe (i.e. pipe diffusion of Fe) along the dislocation core. The origin of Fe was probably from the primary olivine itself, because the antigorite formation from Fe-bearing olivine essentially causes ejection of excess Fe.
This result indicates that the Fe component released from olivine during serpentinization diffuses into its original olivine by Mg ? Fe interdiffusion.

Murata et al., (2009a) Geosphere 5 :90-104. doi:10.1130/GES00213.1, Murata et al., (2009b) J Mineral Petrol Sci 104: 199-203

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